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CS 454 Review Exercise

Exercise 4

Dataset

S1: <P1,P2,P5,P2,P7,P3>
S2: <P1,P4,P5,P1,P6,P7>
S3: <P1,P6,P1,P4>
S4: <P5,P4,P1,P6,P7>
S5: <P5,P3>
S6: <P1,P2,P7,P3>
S7: <P2,P7>
S8: <P1,P2,P4,P1,P2,P6,P7,P3>

Similarity(P4,P6) = Similarity(P5,P7) = 0.9
IF i = j **THEN** Similarity(Pi,Pj) = 1
IF i != j **THEN** Similarity(Pi,Pj) = 0

Problem

Use the Needleman-Wunsch Algorithm to determine the best alignment of S3 and S4.

S3: <P1,P6,P1,P4>
S4: <P5,P4,P1,P6,P7>

		j = 0	j = 1	j = 2	j = 3	j = 4
			P1	P6	P1	P4
i = 0		0	-10	-20	-30	-40
i = 1	P5	-10	-10	-20	-30	-40
i = 2	P4	-20	-20	-20	-30	-10
i = 3	P1	-30	**0**	-10	0	-10
i = 4	P6	-40	-10	**20**	10	**0**
i = 5	P7	-50	-20	10	**10**	0

A(i, j) = Max[A(i-1, j-1) + S(Xi, Yj); A(i-1, j) + d; A(i, j-1) + d]
$s(X_i,Y_j)$ = -10 + 30 * Page_Similarity

A(1, 1) = Max[A(0, 0) + S(P5, P1); A(0, 1) + d; A(1, 0) + d]
= Max[0 - 10; -10 -10; -10 -10]
= Max[-10; -20; -20]
= -10

A(2,1) = Max[A(1, 0) + S(P4, P1); A(1, 1) + d; A(2, 0) + d]
= Max[-10 -10; -10 -10; -20 -10]
= Max[-20; -20; -30]
= -20

A(3, 1) = Max[A(2, 0) + S(P1, P1); A(2, 1) + d; A(3, 0) + d]
= Max[-20 + 20; -20 -10; -30 -10]
= Max[0; -30; -40]
= 0

A(4, 1) = Max[A(3, 0) + S(P6, P1); A(3, 1) + d; A(4, 0) + d]
= Max[-30 -10; 0 -10; -40 -10]
= Max[-40;-10;-50]
= -10

A(5, 1) = Max[A(4, 0) + S(P7, P1); A(4, 1) + d; A(5, 0) + d]
= Max[-40 -10; -10 -10; -50 -10]
= Max[-50; -20; -60]
= -20

A(1,2) = Max[A(0, 1) + S(P5, P6); A(0, 2) + d; A(1, 1) + d]
= Max[-10 -10; -20 - 10; -10 - 10]
= Max[-20; -30; -20]
= -20

A(2, 2) = Max[A(1, 1) + S(P4, P6); A(1, 2) + d; A(2, 1) + d]
= Max[-10 -10; -20 -10; -20 -10]
= Max[-20; -30; -30]
= -20

A(3, 2) = Max[A(2, 1) + S(P1, P6); A(2, 2) + d; A(3, 1) + d]
= Max[-20 -10; -20 -10; 0 -10]
= Max[-30; -30; -10]
= -10

A(4, 2) = Max[A(3, 1) + S(P6, P6); A(3, 2) + d; A(4, 1) + d]
= Max[0 + 20; -10 -10; -10 -10]
= Max[20; -20; -20]
= 20

A(5, 2) = Max[A(4, 1) + S(P7, P6); A(4, 2) + d; A(5, 1) + d]
= Max[-10 -10; 20 -10; -20 -10]
= Max[-20; 10; -30]
= 10

A(1, 3) = Max[A(0, 2) + S(P5, P1); A(0, 3) + d; A(1, 2) + d]
= Max[-20 -10; -30 -10; -20 -10]
= Max[-30; -40; -30]
= -30

A(2, 3) = Max[A(1, 2) + S(P4, P1); A(1, 3) + d; A(2, 2) + d]
= Max[-20 -10; -30 -10; -20 -10]
= Max[-30; -40; -30]
= -30

A(3, 3) = Max[A(2, 2) + S(P1, P1); A(2, 3) + d; A(3, 2) + d]
= Max[-20 + 20; -30 -10; -10 -10]
= Max[0; -40; -20]
= 0

A(4, 3) = Max[A(3, 2) + S(P6, P1); A(3, 3) + d; A(4, 2) + d]
= Max[-10 -10; 0 -10; 20 -10]
= Max[-20; -10; 10]
= 10

A(5, 3) = Max[A(4, 2) + S(P7, P1); A(4, 3) + d; A(5, 2) + d]
= Max[20 -10; 10 -10; 10 -10]
= Max[10; 0; 0]
= 10

A(1, 4) = Max[A(0, 3) + S(P5, P4); A(0, 4) + d; A(1, 3) + d]
= Max[-30 -10; -40 -10; -30 -10]
= Max[-40; -50; -40]
= -40

A(2, 4) = Max[A(1, 3) + S(P4, P4); A(1, 4) + d; A(2, 3) + d]
= Max[-30 + 20; -40 -10; -30 -10]
= Max[-10; -50; -40]
= -10

A(3, 4) = Max[A(2, 3) + S(P1, P4); A(2, 4) + d; A(3, 3) + d]
= Max[-30 -10; -10 -10; 0 -10]
= Max[-40; -20; -10]
= -10

A(4, 4) = Max[A(3, 3) + S(P6, P4); A(3, 4) + d; A(4, 3) + d]
= Max[0 -10; -10 -10; 10 -10]
= Max[-10; -20; 0]
= 0

A(5, 4) = Max[A(4, 3) + S(P7, P4); A(4, 4) + d; A(5, 3) + d]
= Max[10 -10; 0 -10; 10 -10]
= Max[0; -10; 0]
= 0

Best Alignment

S3: <P1,P6,P1,P4>
S4: <P1,P6,P7,P4,P5>